

Buildings Cooling Heating and Power

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INTEGRATED
ENERGY SYSTEMS



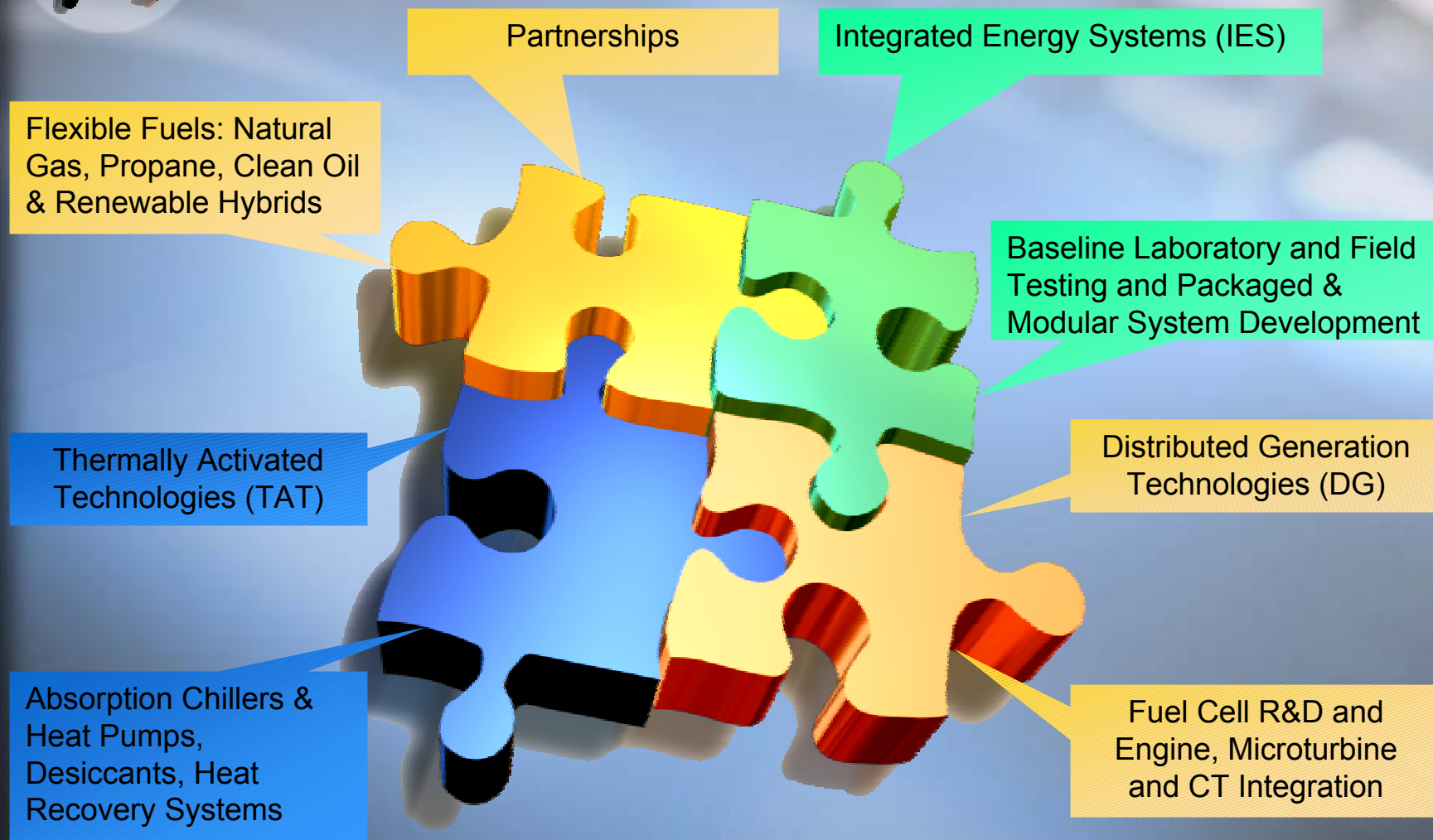
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ENERGY RESOURCES



US DOE
OFFICE OF POWER TECHNOLOGIES



Buildings Cooling Heating and Power





Strategic Approach

- Complete development of TAT hardware that can be effective in either direct-fired or waste heat utilization applications.
- Evaluate TAT equipment integrated with DG equipment.
- Develop “first generation” BCHP packaged and modular systems.
- Partner with industry, ESCOs, utilities, universities & state agencies.



Benefits to Utilities & ESCOs

Gas and Electric Utilities and Independent ESCOs can benefit from BCHP because:

- The increased financial leverage (ROI) provides more competitive offerings for utility/ESCO ownership and operation of building energy systems.*
- BCHP is the only way to achieve the necessary improvements in systems reliability, durability and efficiency to provide competitive offerings in the future.*
- BCHP is the only way to assure that building codes and other regulatory barriers are brought in line with the benefits BCHP building systems offer*



Benefits to Manufacturers



- ◆ **Manufacturers directly benefit from BCHP because:**
 - ◆ Absorption chillers and desiccant dehumidification system manufacturers benefit from BCHP because the efficiency contribution of using their equipment is key to BCHP projects.
 - ◆ Fuel cell, microturbine, gas turbine and IC engine manufacturers need BCHP integrated system to increase customer ROI to secure more business.
 - ◆ Controls manufacturers are seeking differential advantage in competitive market and BCHP provides this.



Benefit to Owners

- **Customers can benefit from BCHP because:**
 - **BCHP offers very low cost operation**
 - **BCHP often improves power reliability and power quality**
 - **BCHP provides a hedge against uncertain power pricing especially among poor load factor costumers like office buildings.**



Benefits to Society

America can benefit from BCHP because:

- *30% or better improvement in primary energy efficiency*
- *45% or better reduction in CO2 Emissions*
- *Improved IAQ through the increased use of desiccant dehumidification*
- *Economic benefits through improved GRID reliability (I.e. reduced peak time blackouts)*
- *BCHP is a classic case where government catalyst is essential as individual companies could not succeed.*





Strategic Approach

- **Develop cost effective BCHP technologies**
- **Address regulatory, institutional, and market barriers.**
- **Demonstrate and verify the benefits of expanded use of BCHP**
- **Develop and validate analysis and design tool software.**
- **Document and widely disseminate results to stimulate market.**
- **Develop advanced, “next generation” BCHP systems.**





Four Key Challenges

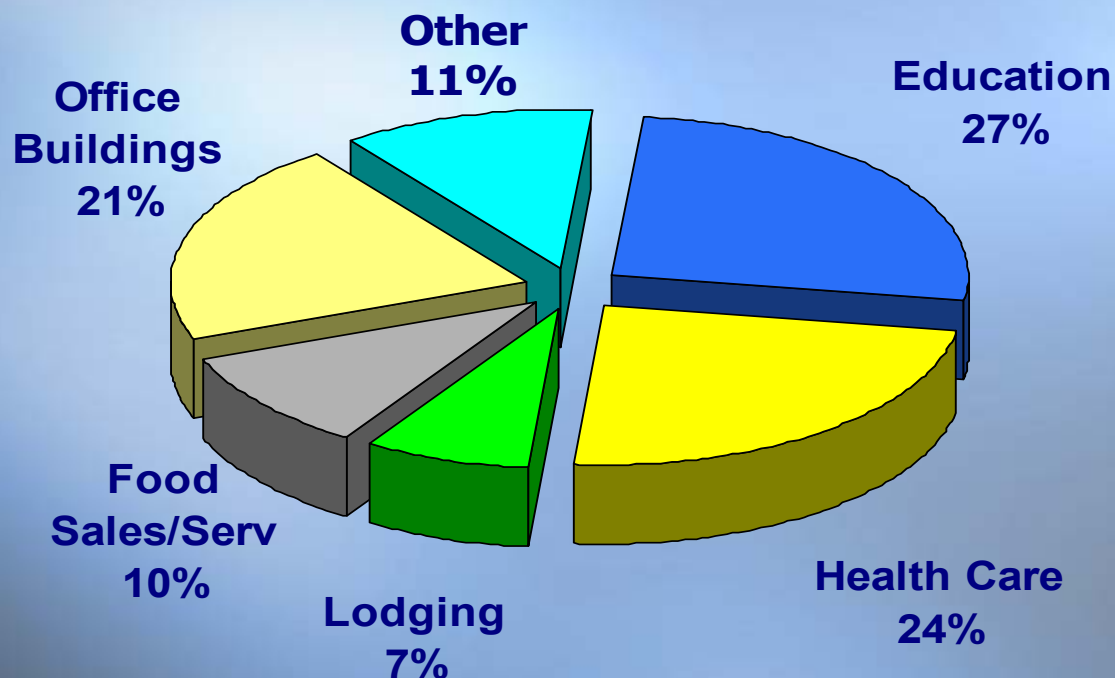
- ◆ **Thermally Activated Technology**
 - ◆ Absorption Cooling
 - ◆ Ventilation Air Conditioning – Humidity Control
 - ◆ Heat Recovery Devices
 - ◆ Thermal Heating
- ◆ **Onsite Power Technology**
- ◆ **Systems Integration**
 - ◆ Controls Development
 - ◆ Building Load Integration
- ◆ **Barrier Removal, Education and Technical Assistance**





Market Focus and Potential

BCHP Potential: 75,000 MW



Source: U.S. DOE-EIA and Onsite-Sycom





Partnerships

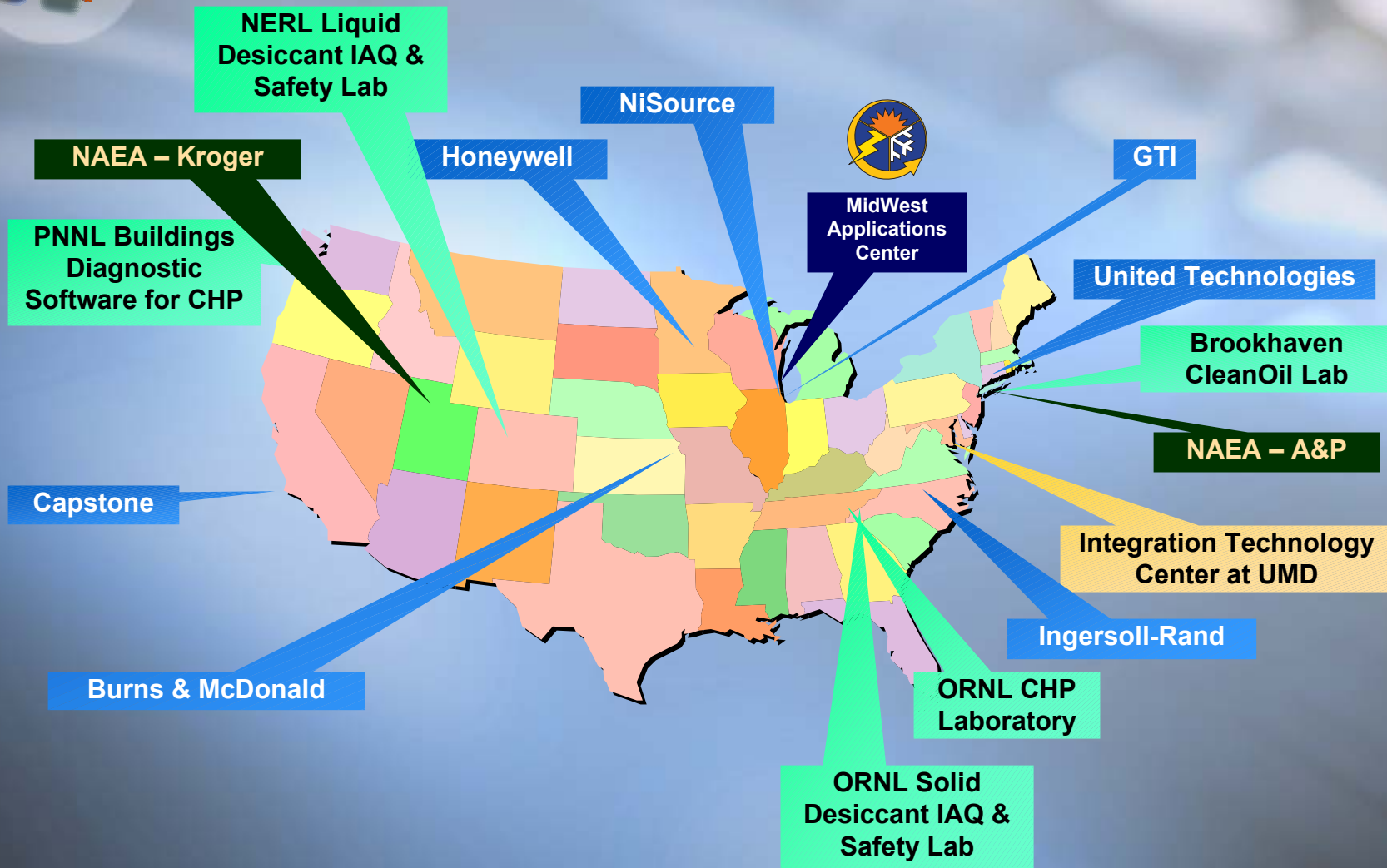


- Industry led effort to develop Thermally Activated Technologies (TAT)
- Integrated DG and TAT equipment into Integrated Energy Systems (IES)
Integrate IES into buildings, campus facilities and district energy plants



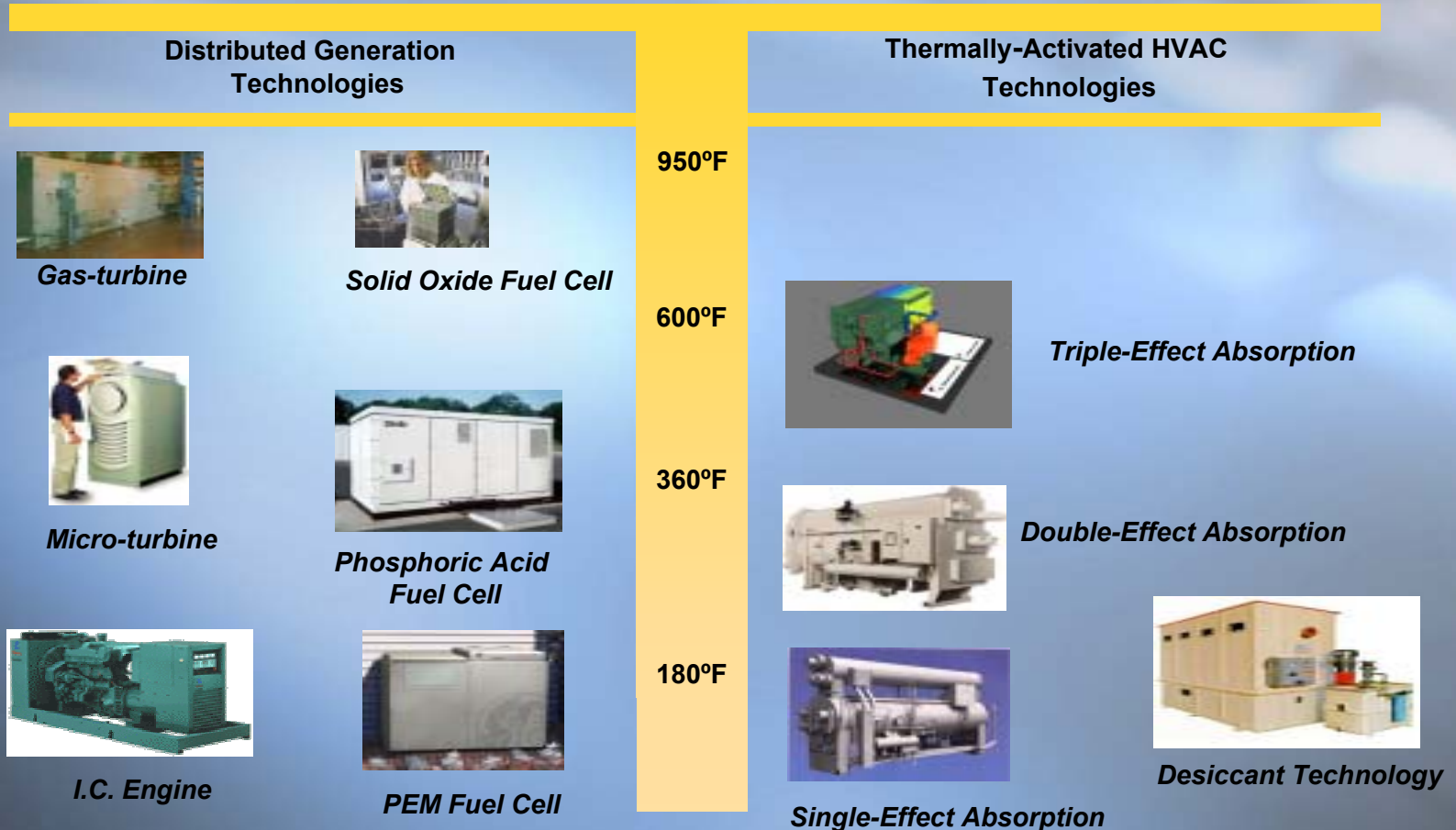


Partnerships - Diversified Portfolio





Thermally-Activated HVAC Technologies are Key to Improving Overall Efficiency of DG



Recoverable Energy Quality (Temperature) and HVAC Technology Match





Thermally Activated Technology

- ◆ **Absorption Cooling**
- ◆ **Ventilation Air Conditioning – Humidity Control**
- ◆ **Heat Recovery Devices**
- ◆ **Thermal Heating**



Absorption Heat Pump/Chiller – Near Term

- Residential/Light Commercial Application
- Ammonia/Water Design
- 3 To 7 Ton Modules For Residential/Light Commercial Use
- Direct-fired Performance 0.7 COP Cooling & 1.4 COP Heating – Targets Met In Laboratory 2001
- Field Test Chiller 2002, HP 2003



5 RT Chiller Prototype



3 RT Heat Pump



5 RT Product Concept





Absorption Chillers – Near Term

- Exhaust-fired absorption chiller integration in IES systems
- Co-fired double-effect chillers
- Triple-effect chillers



Exhaust Gas-Fired Single-Effect
Broad USA Chiller



Trane Single Effect
Steam/Hot Water Chiller



York 450 RT Triple Effect
Chiller Prototype





Desiccant Technologies – Near Term

- ◆ Industrial dehumidifiers
- ◆ Commercial – cold footprint applications
- ◆ Commercial ventilation air systems for humidity control in humid climates
- ◆ Focus is on cost reduction breakthroughs and fundamental application knowledge





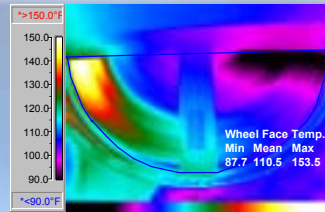
Desiccant Technologies – Near Term



**Desiccant System Testing
ORNL**



**Fundamental
Field Research in
Moisture
Management and
Desiccant System
Technology
ORNL**



**Desiccant Component Test Facility
NREL**



**Liquid Desiccant System Development
NREL**

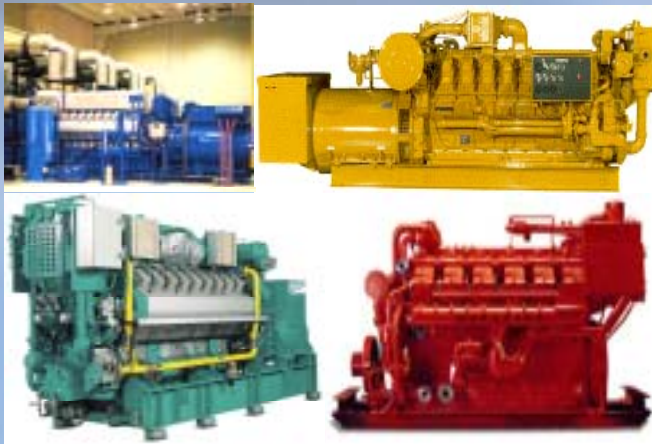




Onsite Power Technologies



Onsite Power Technologies



Integrate with Jacket and Exhaust Systems



Develop Exhaust Gas Powered TAT



Provide TAT Information to Design Teams



Develop Exhaust Gas Powered TAT





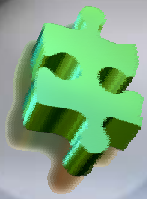
System Integration

- ◆ **Equipment Integration Research**
- ◆ **Building Integration Research**
- ◆ **Modular and Packaged System Development**

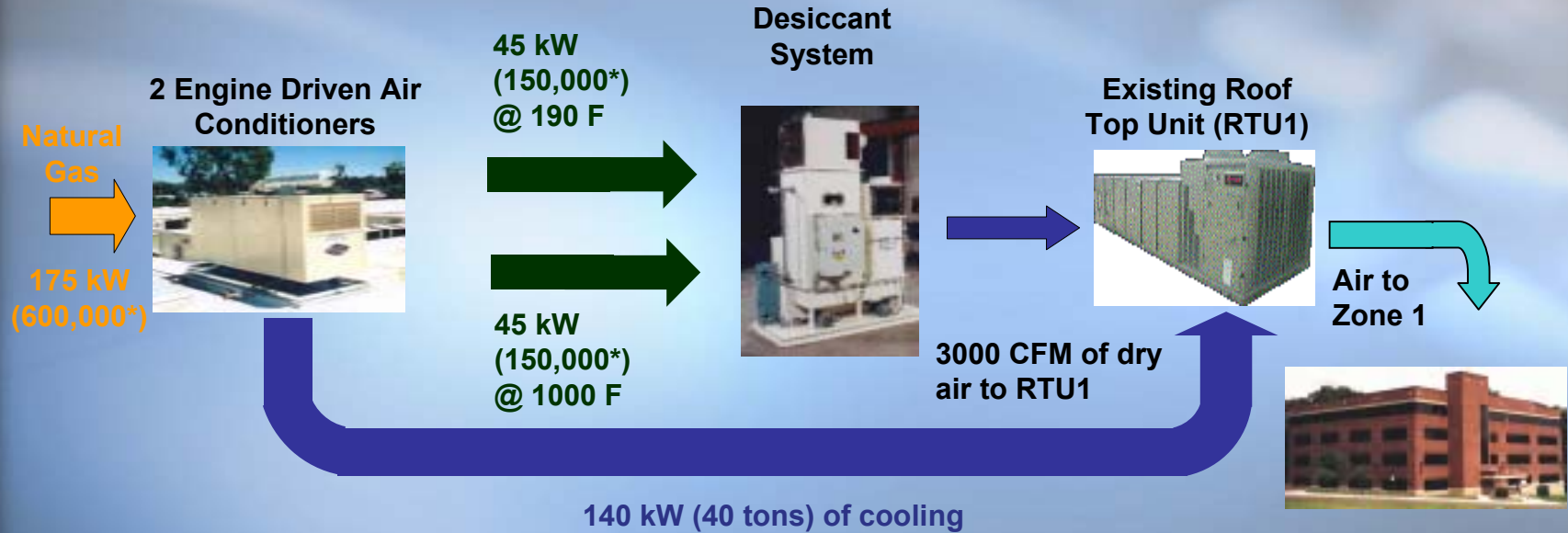


Integration Test Center at UMD



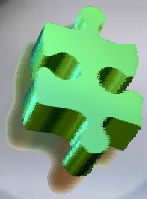


Integration Test Center at UMD

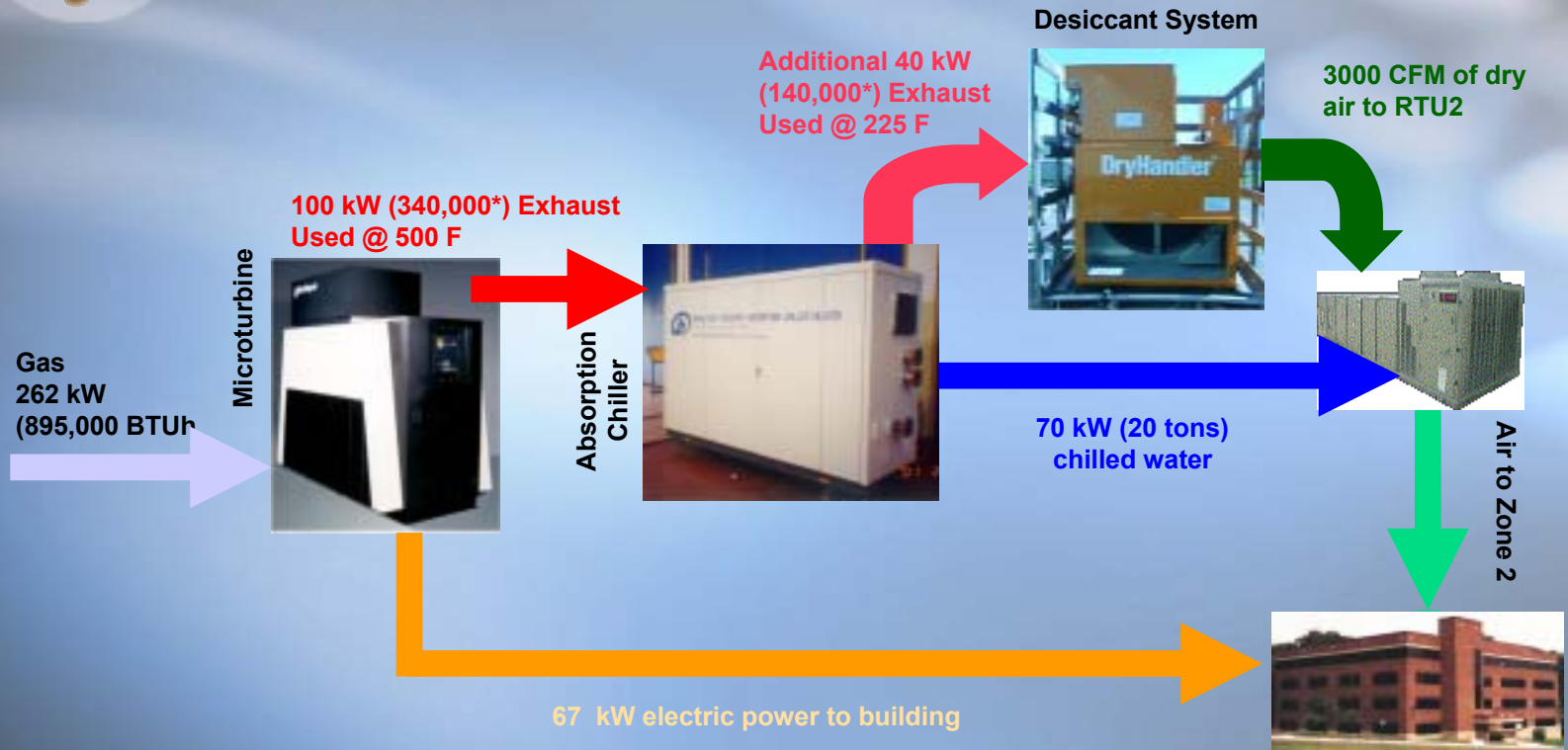


- Engine Jacket Water & Exhaust Used to Regenerate Desiccant
- Liquid desiccant only waste heat driven
- Overall Efficiency up to 80 %





Integration Test Center at UMD



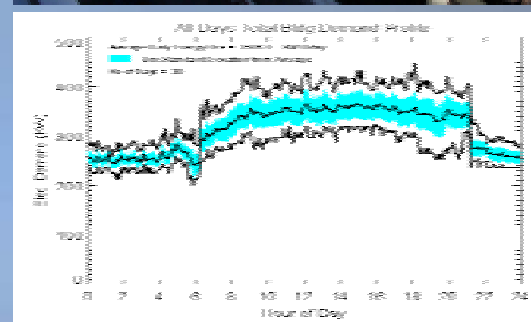
- Turbine efficiency 25.6 %, with chiller 63.5 %, and with desiccant 79.2%
- Single Effect Absorption Chiller with COP of 0.7
- Supplemental cooling provided by existing RTU

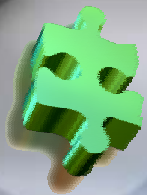




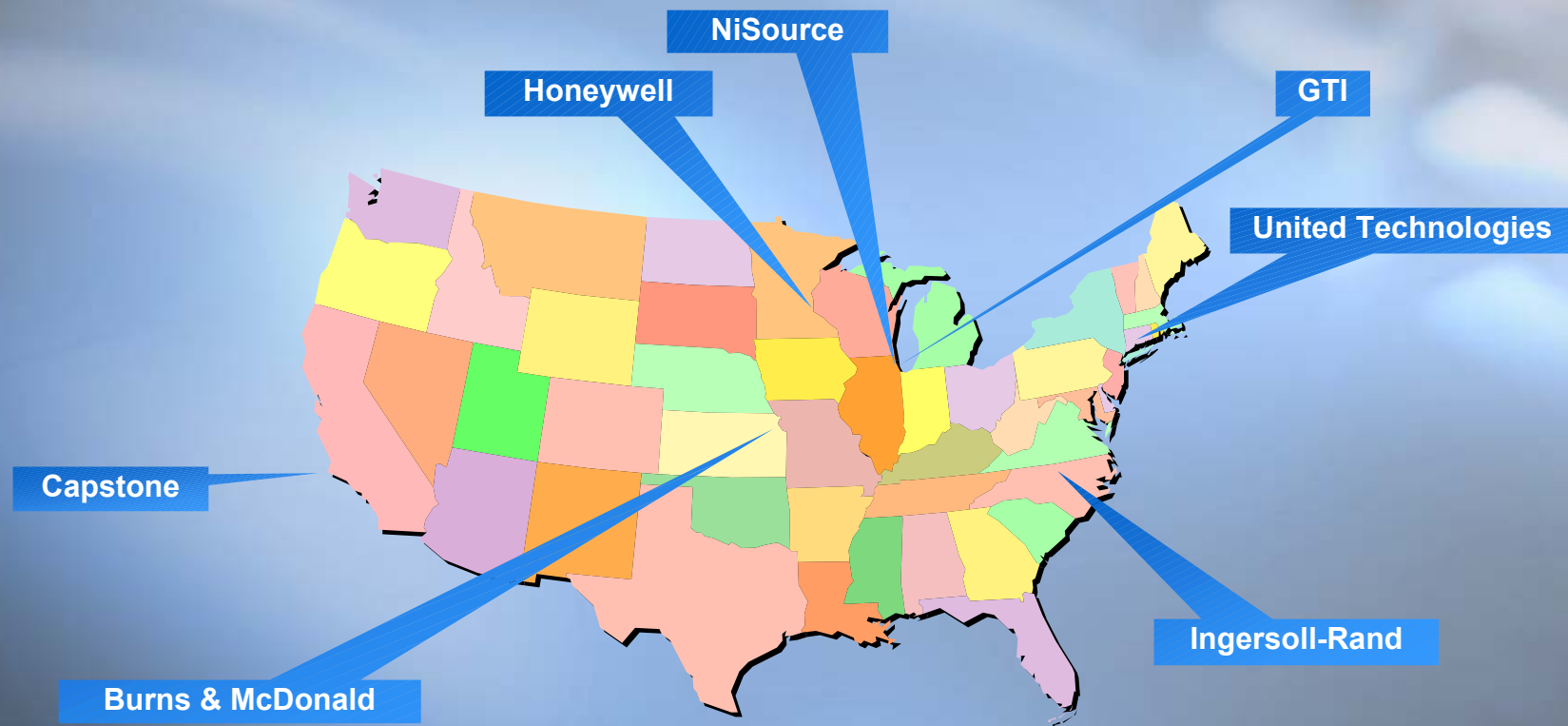
Building Integration Verification and Testing

- Seeking real world answers to improve tomorrow's energy solutions
- In Partnership:
 - Kroger
 - AGA
 - GTI
 - DOE – ORNL
 - Questar





Packaged and Modular IES Development



Thank You

Ronald Fiskum